Chapter 2: Review of Literature

2.1 Introduction

An exhaustive and careful review of earlier studies is mandatory and very much essential for any research work which will help to collect information and to identify the present scenario of the problem which is being selected for the study. Accepting this basic fact, a serious attempt has been undertaken to review the past studies and available literature on tank irrigation. The source include articles, books, conference paper, online magazine, published research paper at the national and international level. The review of literature is undertaken in different areas of the problem which are discussed below.

2.2 Multiple Uses of Tank Irrigation System

Raju and Shah (2000) studied about the role of tanks and its benefits towards the livelihood pattern of the people. He treated tanks or ponds as the storage of runoff in the monsoon. He thought that tanks play an important of insurance against drought in dry or summer seasons. Moreover he identified multiple uses of tank in the village economy Tanks play the role of recharge or top up of ground water, production of crops, domestic uses and balance in the eco system. Tanks regarded as common property play a crucial role not only in the agriculture production but provides fodder, help in producingbaskets, bricks, pots, which are generally produce by the women section of the rural community. In this study emphasis had been given for the

maintenance of tanks through a continuous process which will ensure the livelihood of rural people, reduce conflicts among the users, increasing activities of women and keep balance in the environment.

Palanisami and Meinzen Dick (2001) had pointed out multiple uses of tanks. Tanks mainly act to store water for the community. Tank water is used to produce brick, to grow trees, grazing field, for cattle breeding of livestock and for fisheries. Hence tanks play a unique role for earning livelihood and provide economic and environmental security to rural community.

Sengupta (1985) opined that small water bodies which are used for domestic and agricultural activities can be found in most of the countries.

Seenivasan (2001) studied about the role of caretaker or manager for the efficient tank utilization. He studied in south Indian states and found that every tank has a manager named Neerkattis or Neerkuntis or Kambukattis or Thottis or Thalayaris. There is no consensus regarding the number of these water managers in south India. But these water managers play an important role in the productivity of tank. They take the responsibility of security of tank against flood and any kind of natural calamities. They also take immediate steps from the wind falling of trees, branches, landside of bund on the tank. They take care of sluices so that water had not been drainage in my way. He pointed the positive role of these water managers for the proper maintenance of tanks. But due the recent water management policies there is no existence of such water manager in the south Indian states. Decline in the system of water manager creates unemployment in the rural economy in such states.

Vidanage et al (2004) in their study revealed that tank system is the life line for the rural community of Sri Lanka as it provides water for domestic and

agricultural activities. Moreover, tanks provide livelihood to the rural people and keep balance in the biodiversity.

DHAN (2004) published a report in which multiple uses of tank had been taken into consideration in the state of Tamil Nadu which helped poor marginal farmers to earn their livelihood. Utilisations of the tank ecosystem are drinking water for the man and animals, ground water recharging, agricultural irrigation, animal husbandry, pisciculture, etc. Tanks are also used for the shelter of birds on the trees on the bunds and helped to maintain balance in the biodiversity. So, tank system has to be utilized and managed in such a sustainable way, which will give benefits and security to the millions of poor people in rural economy.

Palanisami (2006) in his study recommended that tank irrigation played an important role in the production of primary and allied sector in South and Southeast Asia. Tanks which are used for multiple purpose activities are century old. Tank irrigation has been utilized in southern part of India and Sri Lanka from time immemorial. For the poor and marginal farmers tank irrigation system play a central role as it is less capital intensive.

Vasimalai (2006) reported in his study that tanks provide safety and security to the rural community in a great manner. Tanks had been identified as moderators of flood in the monsoon and mitigators in the summer. So, natural calamities like flood and drought can be checked through the proper utilization of this resource.

Kajise et.al (2007) in his study identified the role of Water User's Organization (WUO) for the collective management and maintenance of tanks. WUO takes the responsibilities of cleaning and de-silting of storage area, cleaning of supply channels and taking decisions regarding the

distribution of water among the users. For the large tank with more than 40 hectare is maintained by P.W.D. department. Whereas small tanks are traditionally managed by WUO through collective efforts.

DHAN in its report of 2008 has identified that tanks in the Indian subcontinent are basically used for store of monsoon runoff in the semi-arid as well as in the arid regions in all types of soil except in sand.

2.3 Declining Trend of Tank Irrigation

Palanisami and Flinn (1989) examined the causes of downfall of tank irrigation system. Allocation and distribution of water are the major appropriation problem which reduces the tank performance and causes reduction in the rate of yield of agricultural production.

Balasubramanian and Gobindasamy (1991) had identified that because of lack of modernization tank irrigation system had been declined over the time.

Reddy et al (1993) and Gireesh et al (1997) reported that excess pressure of increase in population density leads to reduction of benefits obtained from the tank by the users. As a result people's interest to participate into tank management and maintenance is going to decline over time. This accelerated the process of downfall of irrigation tank in India. Development of well irrigation is another important reason behind the decline of tank system because of the technological benefit and ownership of private tank.

Mosse (1997) opined that in the ancient time it was the zamindar or local rulers or kings who not only take the responsibility of building the tank but also investing fund for the maintenance of tank. Community's role for

maintenance was very much negligible. Tank irrigation system started to decline due to the gradual fall of community participation in the maintenance, and restoration of tank.

Anurag and Mohan (1997) examined the factors responsible behind the downfall of tank irrigation system. In this study they pointed out several factors which are lack of maintenance and management, loss of water supply due to seepage in distribution channels, decrease in storage capacity due to siltation. They suggested for the technically, socially and institutionally viable method which will help to revive the tank capacity and hence will be utilized for the sustainable irrigation for agricultural activities.

Mosse (1999) examined that because of shortfall of propermaintenance and lack of participation of local people in the community management of tank, tank irrigation system had been declined in nineteenth and twentieth centuries.

Shanmugham (2001) studied that due to the lack of maintenance of tank over time, tank irrigation system gradually is going to decline. Maintenance includes cleaning of supply and distribution channels, repairing of bund, repairing of sluice, cleaning of tank bed which is not properly addressed. As a result storage capacity reduces, and tank ultimately became inefficient for utilization. Moreover due to encroachments and urbanization tank irrigation had been declined with the progress of time. Strong participation of farmers is needed for the restoration and rehabilitation of tank which was revealed through this study.

Reddy and Bhagirath (2004) in their study intended to find out the causes of downfall ofsystem of tank irrigation in Tamil Nadu. Analysis based on household data of a village in Tamil Nadu, it is revealed that, due to the

excessive pressure of population, lack of community participation in the proper and scientific maintenance of tanks, capacity of tanks as a protective source of irrigation had been declined over time. They identified the reason of declining community participation in the tank irrigation management and the rise of well irrigation which is basically private in nature.

Sakthivadivel (2005) summarized the factors which influencing the decline of tank irrigation system are siltation of tank water bed, encroachment, leakage in the supply channel, damage of sluices and weir absence of community participation in tank maintenance work and tank management, lack of institutional management for maintenance of tank, unscientific cut down of tank bunds, excessive urbanization etc.

Palanisami (2006) investigated why the century old tank irrigation system had been degraded and declined over the time in India. He found that irrigation tanks had been declined because of the miserable failure of industrial rule of local govt. to project such common property resources because of inappropriate property relations. Moreover encroachment, privatisation, siltation or solid depositions in the tank bed, deforestation around the tank are the major reasons behind the downfall of irrigation through tank system in our country. Tanks which are supposed to be the security against the drought situation in the summer, becoming defunct due to lack of storage capacity.

Kajisa et al (2007) tried to find the factors behind the downfall of tank irrigation system. This study also examined the relationship of yield and income gap among the farmers without wells and with wells. This study tried

to find the impact of decline of tank irrigation this issue.

2.4 Need of Rehabilitation of Tank as a Source of Irrigation

Shanmugum (2001) examined the relationship between poverty and tank rehabilitation. With the tank rehabilitation work rural people able to use tank irrigation system in the expected manner which will generate more income and in turn increase the standard of living. Basically marginal farmers are more benefited as renovation on of tank will give them more access of irrigation water through tank as more farmers do not have facilities of large irrigation system. It was suggested in the study that for rehabilitation work local people's participation i.e. users' participation is regarded as the main driving force. Since rehabilitation work gives opportunity to the uses for the sustainable use of tank water, they must take the responsibility of maintenance of tank in regular interval so that efficiency of tank should be restored for future use. Proper planning with long term perspective is needed to implement rehabilitation work through the wholehearted participation of the users.

Peera and Kallesoe (2004) explained environmental sustainability and enhancement in the standard of living through better opportunity of livelihood can be achieved through the proper planning and techniques. It is observed in the study that mainly labour intensive techniques i.e. local people participation is needed for the tank rehabilitation work since role of capital equipments is negligible or nil, naturally benefits is larger than cost of rehabilitation work.

Palanisami and Kumar (2004) expressed their views in favour of development of watershed activities for agricultural production to use tank water resources property which will in turn generate socio-economic benefits to the people. In this regard they the acknowledge to consider the storage capacity, ground water recharge, cropping pattern and other socio-economic parameters for the growth of watershed management.

Palanisami (2006) examined that chain system supply of water into the tank had been ruined and as a result chain system tanks became inappropriate in almost all the cases for agricultural activities. The study showed an emergency all for taking proper action to take appropriate renovation strategies for the revival of chain system tank in south India. Instead of taking a plan for a particular water tank, a plan should be taken by considering the whole cascades of tank for improve supply of water in the command area. To reduce pressure on the supply chain the study suggested for the alternative provision for water supply and for that new water tank should be excavated over the command area through the community investment.

Pathak et al (2007) opined that development of watershed management led to numerous benefits to the users and community as a whole. Watershed development programme increasing the ground and surface water availability which will ultimately enhance agricultural productivity and crop intensity. This also gives opportunity to the community people for diversified use of tank in pisciculture, vegetable production, horticultural and lives stock breeding. For this community participation in water shed management is regarded as the principle source to achieve target of multiple use of such programme.

Thamana (2008) studied the results of tank rehabilitation programme and its impact or benefits to the users. Rehabilitation of tank increase the potential use of both the purpose of drinking needs and for irrigation needs during dry seasons. This will also increase the employment potential through the increase of man days for work and hence as a result opportunity of livelihood and standard of living will increase. Defunct tanks can also be taken for rehabilitation which will enlarge periphery of water availability and hence will help to increase agricultural productivity and benefited the vast section of people in rural area. The study revealed that this rehabilitation work benefited much to the poor and landless people.

2.5 Benefits of Tank Renovation

Tubpin et al (1982) in a study in Thailand explained the cost benefit analysis of tank renovation work. The result shows that efficient investment for rehabilitation work will increase use of water in domestic area in agriculture, for fish production which will reduce the inequality of distribution of income and wealth.

Govindasamy (1991) studied the good effects of tank rehabilitation through the development of simulation model accepting different aspects or scenarios of renovation or modernization. This includes the modernization of sluices, improvement of catchment and supply channels, excavation of tank bed etc. This study also suggested mat rehabilitation of canals is the best option of renovation to implement because this scope is much wider than tanks.

Palanisami (1991) used simulation model to show the co-relation between capacity of storage with extent of rainfall, volume of run-off and volume of evaporation, delivery system of water to the field for production of crop. The

study suggested a ratio of productivity which shows that greater the ratio, greater will be the empowerment. The study also proposed an equity ratio i.e. the ratio of net returns per hectare of the farms at the head and trail end. Due to the differences in the equity ratio different approach had to be adopted.

Govindaiah(1994) expressed that for the tank rehabilitation people participation and investment is needed. Cost-benefit approach should be taken for the success of the rehabilitation.

Ram (1995) suggested that appropriate management strategies should in incorporated for the change of crop pattern. Due to siltation, water storage capacity ofwater in the tank had been reduced over the time. Silt should be removed and this gouge out silt should be used for construction or repairing bunds.

Gireesh et al (1997) tried to investigate whether tank rehabilitation work is economically viable or not in some dry parts of eastern Karnataka. From the cost benefit analysis it was found that tank rehabilitation work was economically and financially benefits the analysis had been conducted on the date collected from the sample farmers around the command area of Kasaraghatta and Mutter tank area.

Turton (2000) in his study summarized the benefits of development of watershed for the long term sustainable use of tank irrigation. It was analyzed that, creation of new physical assets like ponds, wells, bunds, check dams etc. will create better opportunity of sustainable use of tanks. But it was not clearly stated whether the benefit of maintenance will be sustained for long run if it is joint responsibility. Whatsoever, this will recharge the stage of ground water level as well it will create many benefits to the land

owners than groups of people.

Shah and Raja (2002) studied the multiple benefits of tanks in his study. The study revealed that tanks performs as the storage of rain water for future use of irrigation, acts as source of recharge of ground water, use for pisciculture, feeding livestock. Moreover silt excavated from the tank bed will be utilized as fertilizer to grow more crops and vegetables and sometimes is used by the small scale industries for different purposes such as production of bricks etc.

Kamara and Cornick (2002) identified that if small irrigation scheme is appropriately implemented with proper technologies will improve rural livelihood in a better manner with respect to other mode of irrigation. But when the investment responsibility comes totally on the users or on the community, then this method may not be economically feasible off course institutional support for the irrigation scheme may give better result of improved livelihood.

Hussain and Hanjra (2003) summarized the method which will support to study socio-economic benefits of tank irrigation at different levels. Different studies at village, regional, national and international level basically use the methods of (i) comparison with and without use, (ii) Comparison of more or less use. For the analysis of socio-economic benefits data should be collected at village level and tank level before and after the introduction of irrigation schemes.

2.6 Standard Of Living Improvement Through Tank Rehabilitation

Balasubramanian (2000) examined the relationship between tank management and rural poverty. In this paper it was found that contribution of

poor marginal farmers in tank management is much greater than the contribution of non-poor people who do not much depend on the tank water. It was also observed that development of private irrigation wells had an inverse effect on community participation in management of water tank. But it was examined that due to tank rehabilitation rural livelihood specifically among the women section of rural community will be increased through rehabilitation of tank.

Raju and Shah (2002) pointed out in their study that women's participation should be enhanced for better use of domestic water. For that study suggested to encourage for the promotion of association among the women in rural area who can take the productive role for the planning and management of domestic use of tank water.

Narayanmoorthy and Desparde (2003) expressed that standard of living or livelihood of rural people, basically marginal farmers depends on agricultural wage rate. More wage rate can be achieved through adopting the tank renovation or restoration work. Micro credit or small scale credit can play an vital role in this because through women empowerment is possible. Women's participation is crucial to get the larger benefits of rehabilitation programme. Gender inequality is seen in rate of the rehabilitation work which should be removed in order to get better livelihood or standard of living in the rural area.

Hussain and Hanjra (2003) in their study examined the relationship between rural poverty and irrigation with tank water. It was observed in the study the poor farmers who depends more on the tank water for various purposes, generally more participate towards tank management activities with comparisons to non-poor households. It was revealed in the study that

increase in storage capacity due to rehabilitation work can change the livelihood pattern. Specifically women section of rural community can get better livelihood through tank rehabilitation work and hence standard of living of the poor families of the rural area will improve. The study suggested several policy prescriptions for the tank renovation work.

Sophia and Anuradha (2005) examined the relationship between tank rehabilitation programme and multiple livelihood opportunity in a study of 40 rehabilitated tanks in three different states of Pondicherry, Karnataka and Tamil Nadu. It was observed in the study that tank rehabilitation programme has multiple avenues for generating livelihood options among different stakeholders basically the poor landless marginal farmers. The study also examined the role of funding of SHG for restoration and renovation work which ultimately generates opportunity of earning more income among these poor marginalized people in the rural area. It was seen that agricultural productivity, food security had been increased as rehabilitation programme increase the capacity to store water in the tank. But it is noteworthy that study did not find any direct correlation between tank renovation or rehabilitation programme and poverty alleviation, but it was obvious that there will be an opportunity of more earning among rural people.

Anurudha and Ambujam (2012) in their study, they tried to investigate the impact of the tank rehabilitation programme on the efficiency of tank capacity structure which can enhance the livelihood options in rural area. The study observed that due to renovation, irrigation efficiency increases by 12.4% and conveyance efficiency by 14.53%, field channel efficiency by 7.29% and field application efficiency by 0.91% in the post rehabilitation period. Net yield per hectare had been increased by 20-30%. The study

shows serious concerns regarding the role of govt. agencies for the efficient supervision of tank renovation work.

Deivalatha, Senthilkumaran and Ambujam (2012) had examined and evaluated the advantages of tank rehabilitation programme in the village Ponpadi, district Thiruvallur in Tamil Nadu. The rehabilitation work includes desilting of bedsof the tank and supply channels. It was assumed that all these work hopefully increase the crop productivity and income of the farmer. After the data analysis it was seen that productivity indicator had been increased from 4800 to 5400 in the first season and 4425 to 5400 in the second season. Profitability indicator of CBR is increasing from 0.64 to 1.04 in the first season and from 1.13 to 1.31 in the second season. It was also observed in the study that tank rehabilitation programme creates extra employment opportunities. Which is in turn increases income, provide food security and keep balance in the environmental sustainability.

Shashank C. Bangi (2016) summarized the causes of inefficiency of century old irrigation tank. The main reasons are insufficient rainfalls heavy, silt deposition due to the improper and inadequate maintenance of irrigation tank. The study suggested a new development of minor irrigation tank which was designed to proposed for upstream of the old silt deposited tank area to achieve efficient utilization of water in the Cultural Command Area (CCA).

Arivoli and Ambujam (2016) examined the factors behind the inefficiency and decline trend of tank performance are irregular trend of rainfall in the tank area and adequate maintenance of irrigation tank. The study utilized hydrological simulation model for examining the performance of the irrigation tanks which has been rehabilitated during last 15 years in Gomukhi sub basin in Tamil Nadu. System tanks and one non-system tanks were

selected for the analysis. Study revealed that no such significant change on both tanks due to rehabilitation, but one important observation is that field channel should be stretched up to the ends of the field for efficient utilization of tank water resources. Although it was explained in the study that variation in rainfall, temperature variation etc. have great influence on efficiency of tank performance.

Bitterman, et al (2016) examined the relationship between rain water harvesting and agricultural livelihood. The study found that due to the encroachment, and development of private well irrigation efficiency of collectively managed water bodies in the village area becoming inefficient and dominant source of irrigation. The study expressed that rehabilitated tanks increase the potential opportunity of water resources not only in the monsoon but also in the summer. It was recommended in the study that WUA has an important role in the maintenance, management, and distribution of tank water. Moreover, it was also expected that non land owner farmers those who are generally excluded from the participation in the maintenance and management should be taken in the WUA. The study also expressed the views of role of local govt. i.e. Panchayat to prepare budget, making investment plan and in the matter of auction of fish, fruit and other produce.

Jana and Manna (2017) studied participation of the farmers in the maintenance and management of small water bodies' irrigation in the area of saline zone of West Bengal. Component analysis and game theoretic approach has chosen for the analysis. It was revealed in the study that farmers' participation depend on the factors like power of decision making body, and maintenance, water sharing fairness, and water sufficiency etc. It

was noticed in from the game theoretic study that sharing of benefits through the small water body irrigation is not always homogeneous.

Jana, Palanisami, and Manna (2018) studied 22water bodies under RRR and RIDF programme of renovation in saline zone of West Bengal. The study revealed that command area, fishing, type or character of water body, existence of irrigation equipment's, size of investment fund have positive role to NPV. The study revealed serious concern about the management strategies regarding the control of water bodies in the region.

Narayanmoorthy and Jothi (2018) suggested in their study that paddy cultivation through method of inundation is not sustainable as it consumes more water. In fact paddy consumes highest water in India. Instead of inundation method if SRI method is applied, then not only consumption of water will increase but also land productivity will also increase. This showed that by implementing the method of SRI, 40%, irrigation water can be saved, productivity of land will increase by 46% and cost of cultivation will be increased by 23%. But it was also stated in the study that these benefits may vary into different water bodies like tank, canal and ground water irrigated areas.

Reddy, Reddy, Palanisami (2018) studied the multidimensional benefits of traditional tank irrigation system for the development of agricultural productivity and rural livelihood. It was revealed in the study that due to the rapid growth of population and lack of proper maintenance, this productive irrigation system had been deteriorated over the time. Keeping this in view, the study recommended tank rehabilitation programme as to revive the benefits of tank irrigation. It was realized in the study that benefits of

irrigation tank rehabilitation is much greater than the costs across different areas of the country. It was also suggested that govt. should take tank restoration policy by considering the changing scenario of water availability at the ground level and climate variability.

2.7 People's Participation in Irrigation Management

Palanisami and Easter (1984) studied the management strategies and investment alternatives of tank irrigation in South India and concluded that farmer's cooperation for efficient maintenance of tank irrigation was very important. They have suggested farmer's organizations should be encouraged. Further, identification of a strong local leadership was also stressed as a first step in helping farmers to organize.

Raby (1991) evaluated the experience of participatory irrigation management in Sri Lanka and observed that farmers must be included in the process of decision making for the management of irrigation system, empowerment and development.

Teknyel *et at.* (1997) studied Turkish experiences on participatory irrigation management. This study highlighted the achievements in the method of transfer of irrigation management. This study highlighted the achievements in the method of transfer of irrigation technique to the users. Beyond all expectations, it showed remarkable success. The government encouraged participatory approach through establishing Irrigation Groups (IGs) or Water User Groups (WUGs).

Ul-Haq *et at.* (1997) summarized the strategies and models proposed by various agencies for PIM (participatory Irrigation Management) and

evaluated their main strengths and weaknesses. They also discussed major issues and options for improved irrigation performance and outlined the prospects for the farmer's participation and role in the proper Irrigation management. Their overall recommendation was to pursue comprehensive and integrated strategies for improved irrigation management which needed to be done in connnection with the institutional framework of the local society.

Yasin and Ahmad (1997) studied modernization of irrigation technique in Pakistan, of the 17.5 Mha of water available in Pakistan Rivers, 10.5 Mha was lost through inefficiencies in the national irrigation system. In this context the study described the system's major constraints and outlined the rationale for introducing participatory irrigation management for reduced governmental costs, improved system performance, better response to external pressure and improved environmental sustainability of system performance, better response to external pressure and improved environmental sustainability of system.

Heymans (1998) described the implementation of irrigation schemes according to the Scheme Development Process (a participatory irrigation implementation method) within the PATA project (Integrated Agricultural Development Project for selected zones of the Provincially Administered Tribal Areas) in the province of North West Frontier in Pakistan. Farmer managed irrigation scheme was implemented according to a clear step wise approach in which design, construction and extension were integrated. Farmers participated in all decisions and in all steps of the implementation process and paid 10 percent of the investment costs before implementation starts. The study suggested that participatory approaches required time

consuming preparations but in the end produced the required output.

Shashikumar (1998) reported that people's participation noticed to be significant in different programme planning steps viz., implementation, and execution and evolution stages complemented by NGOs in Karnataka.

Sharma (2001) reported that the success ofdevelopment of the watershed management by an NGO Tarun Bahrat Sangha (TBS), based at Kishore village of Alwar district in Rajasthan was due to effective participation of beneficiaries in the programme. The NGO formed a Jal Biradari (water work force), the Biradari has people from rural as well as urban areas, who work togetherfor the development of watershed managementthrough community participation programme.

Chandran *et al* (2001) reported that, farmers' participation through WUAsin the irrigation project of Malampuzhja in Kerala under Command Area Development Programme (CADA) was not verysuccessful. Farmer's participation was very low. This study showed that activities which are taken by WUAs were related with management of irrigation water. Other activities like consolidation of land holders, economically viable group farming and cropping pattern were not given much importance.

Madhavareddy (2001) in his study regarding NGO beneficiaries found that, for the development of watershed programme, people's participation was very high. Different activities taken by NGOs like development plan for work, execution of the plan, and identification of the problems and framing of objectives are the basic steps behind the success of watershed management.

Mirani and Menon (2001) reported that, Sindh is the second important province of Pakistan. It has dual economy, industrialization in Karachi,

Hyderabad and other few cities and agriculture in the rural area. About 70% of the province's population depends on the farming systems for income and employment. The demand for sustainable land and water use for poverty alleviation and food security in the village areas of the province. At present, more than 50% of the population in rural area is estimated as poor. Among other causes salinity, water logging and degrading about 40% of the cultivated area in the province. The Government of Pakistan through the provincial governments has introduced the institutional reforms, envisaging farmer's participation in therestoration, renovation, management of irrigation and drainage system. It is expected that the reforms would reclaim degraded land, increase the cropping intensity on the same discharge of water courses, and ensure equitable distribution of water.

KadirAbdul*et* al (2002) recorded experiences in farmers' management of large scale irrigation and drainage projects in Nigeria. Nigeria's experience in farmers' participation in management of irrigation and drainage schemes has been described and the general status of both irrigation development and participatory irrigation management has been outlined. Seven projects were briefly reviewed to assess the levels of farmer's participation in local project management. Nigeria had not yet recorded many success stories on PIM (Participatory Irrigation Management), PJM (Participatory Joint Management) or on WUAs (Water User Associations). Two cases of fairly success of PIM and WUA activities have been noted - at KRIP (in Kano State) and in Jigawa State. At the state level, there were also reports of WUAs functioning marginally satisfactorily at 3 schemes. While the future of PIM and WUAs is highly promising in Hadejia Valley, most other places showed much less promise of WUA sustainability.

Mohan (2002) discussed the earlier and recent experiences with participatory irrigation management (PIM) and the irrigation tank systems inAndhra Pradesh, and Tamil Nadu, India. The implications of the existing water policy in the light of irrigation tank systems were discussed. The effective involvement of water user's associations can be terms of financial resources and decision-making abilities.

Wijayaratna (2002) reviewed five resource papers and thirteen selected country papers from the APO Seminar on Organizational Charge for participatory irrigation management held at Philippines. The country papers revealed that all the participating countries took initiatives in PIM. The efforts and successes, however varied across countries due to country-specific socio-political, economic, cultural, and historical factors as well as due to differences in relation to such factors as the stage of irrigation development, characteristics of the organizational structures established for irrigation management and the degree of external assistance.

Douglas and Vermillion (2004) studied on irrigation, collective action, and property rights. They observed that Governments were shifting their role from direct control of irrigation systems to regulation of the water sector, provision of support services to WUAs and capacity building among water user associations and irrigation service providers. International experience suggested that irrigation sectorcan be made successful through the establishment of policy working group and national secretarial group which co-ordinate to each other for the implementation of proper planning and management. The process included strategies such as participatory management planning, research and stakeholder consultations: mobilization of political support, framing and adoption of an effective policy, legal

institutional and regulatory structure, planning to coordinate lending and assistance for technical support, public awareness campaigns and monitoring, evaluations and course corrections.

Hyed and Neef (2004) in a study regarding the management of water analysed that constitutional right for the practice of participation of people is an essential precondition for the development activities and conservation of natural resources. To shoot out the problem of water crisis in northern Thiland, decision makers and Govt. officers has to changes their attitude and mobilising local people through proper training to solve the water crisis. Communities and individuals need to be made aware of their constitutional rights and potentials for cooperating with government agencies and participating in their projects.

Sakthivadivel *et. Al* (2004) reported that, a survey of 41 irrigation tanks in 22 districts of 8 Indian states was conducted under the programme of IWMI-Tata had identified the characteristics of high-performing local-managed tank institutions. This paper discusses some best management practices used by high-performing tank institutions with respect to the following key functions: water acquisition, water allocation and distribution, decision making, enforcement of rules and punishment of violators and mobilizing financial resources.

Talati and Tushaar (2004) studied institutional vacuum in SSP in Gujarat - framing rules of the game. The Sardar Sarovar Project (SSP) in Gujarat was envisioned that farmer participatory management in irrigation project, role of WUA for the distribution of water through their own distribution channel is essential for irrigation development. The paper suggested that it was unlikely that the overall vision of the SSP for irrigation management will play out for

several seasons to come. Farmers were certainly not ready and even the SSP was not quite ready to implement its strategy. Institutional alternatives for the Sardar Sarovar Project were recommended.

Yoganand and Gebremedhin (2006) identified that natural resources should be utilised in such a manner that poverty reduction by providing food should not hamper environmental sustainability. Sometimes pressures of population growth cause environmental degradation and food insecurity. Further, participatory watershed management approach is proposed to address this problem effectively.

Bhavsar and Bhalge (2007) revealed that Major parts of the earth do not receive the rains throughout the year. They opined that people's participation through community management is one of the successful ways for the water management in India peoples participatory management is required for the optimum utilisation of water resources by building infrastructure for rain water harvesting. This paper illustrates few successful cases of the participatory Irrigation management practiced in India.

Singh *et al* (2008) reported that, for the upliftment of rural poor multidisciplinary as well as multi institutional approach of participatory management should be given more importance. It should be noted that in India people's participation in planning and management and implementation is very weak. This may sometimes hamper the process of environmental sustainability. This led to realization that perspectives of local people's needs to be in the centre of development, research and extension efforts, if substantial impact is to be made. The objective of this paper is to share the experiences of a multi-disciplinary and multi institutional participatory approach undertaken in India, to improve livelihood of community including

poorest of the poor through .integrated land and water management. The purpose here is to establish a more differentiated communication and a conceptual frame work, which can help researchers and practitioners to make better choices and more informed decisions when designing their research, communication and dissemination approaches.

Suresh and Ramesh Babu (2008) conducted a study during 2006-07 in Tumkur district of Karnataka. Most of the respondents had medium extent of participation (64.77%) followed by high (28.33%) and low (7.5%) extent of participation. Majority of the respondents had medium extent of participation followed by high and low in activities like motivational meetings (62.50%, 26.67% and 10.83%), planning (68.34%, 23.33% and 8.33%), implementation (62.50%, 25% and 12.50%), maintenance (67.50%, 28.33% and 4.17%) and evaluation (66.75%, 29.16% and 4.17%).

From the above studies, it could be inferred that large number of farmers had medium levels of participation, large number of farmers has actually participated in the process of planning and implementation stages.

2.8 Impact of Irrigation Management on Crop Productivity and Income of the Farmers

Sisodia (1992) evaluated the impact of warabandi programme on land use, cropping pattern, cropping intensity and yield levels of principal crops in Madhya Pradesh's two selected districts during 1982-83 to 1986-87. As a consequence of introduction of the programme, irrigation ratio had increased from 40.19 per cent in 1981-82 (before warrabandi) to 87.39 per cent in 1986-87. The intensity of cropping showed a modest increase from 104.75 per cent in 1981-82 to 108.93 per cent in 1986-87. After enforcing warabandi, kharif crops as a proportion of net area sown rose to 10.32 per cent, which was worked out to 4.99 per cent earlier and the cropping pattern tilled towards non-food grains, which were more remunerative. The yield rates of bajra, wheat, gram and sugarcane increased by 174 percent, 41.94 per cent 46.87 per cent and 20.83 percent, respectively.

Daghari and Laroussi (1997) studied on research experiment and training for more active farmer's participation in the process of management of different irrigation schemes in Tunisia. Water resources management was coordinated at the central area by the Agricultural Engineering Directorate and at the local level by the Development Bureau. Together with these structures, new organizations had been promoted like the Public Concern Associations that took the responsibility on behalf of farmers in maintenance, distribution and use of waters.

Groenfeldt and Sun (1997) studied the concept of participatory irrigation management and observed that the inefficiency of the public administration and the market failure in managing water resources necessitated new

organizational and managing systems to deal with irrigation policy. User involvement in managing water resources was the most suitable solution to this kind of problem. Spain, USA, Australia and the developing countries had all adopted this practice. Advantages derived from farmer's involvement included a direct knowledge of area specific needs, easier cost control and improved flexibility.

Jairath (1999) studied the participatory irrigation management in Andhra Pradesh. In 1997 the Andhra Pradesh Farmer's irrigation management system Act came into light in 1997 in Andhra Pradesh. This law enable the farmers to take part in the maintenance and management of irrigation systems. She noticed that while that bring to many changes on the of irrigation processand water-use front, the reformation needed to be extended beyond supply-side activities which include the critical domain of end-use regulation of water, which would affect cropping patterns and agricultural practices.

Veni and Bhave (1999) reported that while the income of the largest single group was 30 per cent at a reported level of Rs.2401 to 3500 and the income level of Rs.3501 to 4800 were very close to the frequency. The income of farmers depends on numerous factors like his interest in farming, his involvement in non-agricultural activities and his other economic sources.

Patil (1999) conducted a study on evaluation of land treatment for in-situ moisture conservation in Maize and Sesamum crop on medium deep soil found that, positive change in productivity and increase in fodder production due to development of watershed in different region of the country.

Sharma (2001) reported that, increase in productivity of the crops over the previous year was due to the effective participation of beneficiaries in watershed development programme.

Ramesh and Gowda (2001) reported from a study at Kabbalanla watershed area in Karnataka that comparatively better productivity can be achieved out of limited resources through the proper practice of watershed development than the non-watershed areas.

Behera and Reddy (2002) estimated the effect of water pollution on crop productivity and area under cultivation in Andhra Pradesh. The study reported that the farmers had incurred substantial losses in both area and the yield. Yield loss was about 76 per cent as against 14 per cent of area loss. In general marginal farmers had suffered maximum loss in terms of area (33%). This was because the marginal farmers had no access to well irrigation.

Sridhara (2002) evaluated the study on watershed programme and found that, the productivity in the pre-post projected period by virtue of implementation of DWDP. It could be inferred that percentage increase in productivity obtained by the farmers was considerably higher over pre project period. It should be noted that percentage of people falls between income groups of Rs. 11001 to Rs. 22000 per annum is 43%.

Jiang (2003) in his study found that the formation of WUA had a very strong and positive impact on farmers'WTP in irrigation project. For the development and maintenance of different kinds of infrastructural facilities WUA is the right option for irrigation development and reform in India.

Nirmala (2003) observed and identified in her study that productivity in the watershed area of irrigation, productivity is much higher than non-watershed area. It had also been noted that that watershed area under cultivation showed more productivity than cultivable land not under the coverage of watershed area both in Kharif and Rabi season.

Chandrasekharan *et al* (2004) studied participatory irrigation management for

the optimum use of water and enhanced rice productivity in Tamil Nadu. They reported the results of community based on farm irrigation management trials. Experiments were conducted during 1992-1997 at two different sites of the Cauvery Delta Zone to determine the requirements and benefits of improved irrigation management. Treatments included continuous flooding (control) and improved irrigation management (intermitted). Improved irrigation management reduced water use at the head and middle reaches and spared more water for farmers at the tail-end compared with the control. Under the control treatment, inadequate water supply at the tail-end area led to low rice yields, whereas the improved irrigation management permitted judicious use of water by the farmers and resulted in increased rice yields by 40 percent at the head, middle and tail-end areas. Results indicated that farmers in an irrigation system could increase crop productivity through the judicious management of irrigation water and equal sharing of water from the head to the tail- end area.

Verma *et al* (2004) in their study reported that on national watershed development programme perceived that the average yields per hectare of Soybean, Maize, wheat and Potato were 15.66, 14.59, 2347, and 213.45 quintals. Respectively in NWDPRA area as compared to 10.54, 0.48, 14.76, and 153.34 quintals in non-NWDPRA area.

Charan (2005) in his study on profile of Sujala watershed project beneficiary farmers revealed that, 18% of the respondent families had annual income above Rs.33,000, 48 per cent of respondent families had annual income between Rs. 11,001 to R.22,000.

Hosamani and Janawade (2005) studied the effects of irrigations and nutrient management on groundnut oil yield and characteristics of soil. Results of

investigation revealed that scheduling of irrigations at pre-sowing, pegging, pond formation and pond filling stage recorded significantly higher oil yield (717 kg/ha) over farm practices (619 kg/ha).

Ninga Reddy (2005) in a study on knowledge, degree of participation and facilities derived, observed that most of the respondents under watershed development programme falls in the income group of Rs.11000 to Rs.22000 per annum(60%) followed by Rs.22001 to Rs. 33000(20%) and Rs.11000 to Rs.33000(10%).

Amaranth and Rajap (2006) opined that there had been an increasing realization for rehabilitation and restoration of irrigation tanks with farmers' participation. The study has used the costs and benefits analysisfor tank rehabilitation and financial viability of investment for tank rehabilitation. The gross annual income had been observed higher in the tanks with rehabilitation than the tanks without rehabilitation. Rehabilitated Panchayat tanks with the well having community ownership have earned the highest annual income. The investment expenditure analysis had revealed that the net present value to be positive, the Benefit-Cost ratio found to be greater than 1.5.and the opportunity cost of capital should not be more than the internal rate of return. The study revealed that three investments expenditures for tank rehabilitation work are economically viable. The study has opinedthat tank rehabilitation work had be considered for the tanks without rehabilitation. Besides, initiatives should be undertaken to provide opportunity of supplementary irrigation to crops and to take initiatives for the improvement of PWD tank management programme.

Dasaratharamaiah *et al.* (2006) reported that 10.0 per cent of beneficiaries had income between Rs.7,201 and above 20.67 per cent had income between

Rs.4,801 to 7,200 and 31.33 per cent had income Rs.3,601 to 4,800 and 38.00 per cent had income below Rs.3,600 per annum after implementation of DWCRA. And it was found that there are no persons without any income.

Shanthamani (2007) reported in his study that the programme of watershed management has resulted in significant increase in socio-economic status (9.72) mean score, of land productivity increased in yield of Red gram 1.20 q/acre and jowar 1.02 q/acre and annual income of beneficiaries increased to Rs.22, 950.The study identified that most of the respondents were taken part in all the programmes of watershed management programme and implementation.

Savita (2008) reported that difference in crop productivity in the pre and post project period, in case of sugarcane increased from 35 tonnes/acre to 40 tonnes/acre rising by 5 tonnes/acre. Similarly, in case of redgram increased from 3.5q/acre to 6.0q/acre rising by 2.5q/acre, jowar increasing from 8 q/acre to 13 q/acre rising by 5 q/acre. It was observed that, the increase in annual income of the beneficiaries in case marginal farmers increased from Rs.8,000 to Rs.17,000 followed by, semi medium from Rs. 13,000 to Rs.26,000 medium from Rs. 19,000 to Rs.37,000, big farmers income from Rs.29,000 to Rs.54,000 after implementation project.

Reddy and Behera (2009) had used the method of ‘before and after' and the method of ‘with and without’ methods, this paper evaluated the ecological and economic benefits of tank renovation through the ecological and economic indicators that generally support the rationality for tank renovation in the drought-affected regions. Moreover, the effect is much greater for the

small poor and marginal farmers when compared with rich and large farmers, showing a positive influence on the incidence of poverty. This study also suggests the betterment of the ground water table in the villages under the programme and there have been a significant increase in Rabi crop production per acre. Opportunity of havingfodder has boosted up the livestock economy of the villages with programme. The remarkable economic and ecological resultsof the programme are noteworthy to mention for the tanks restored before 1995- 1996, showing the sustainability and long term possibility of the programme.

Jana, Palanisami and Das (2012) studied productivity of tank irrigation in West Bengal specifically in dry zones and opined that,tanks' productivity changes over different tanks with different ownership categories like personal, community and government. Tank productivity, ceteris paribus, is influenced by the physical factors like the size of tank, crop diversification crops and availability of water.

From the above studies, it could be generalized that there was positive and significant impact of tank irrigation management on the income and crop productivity of the farmers.

2.9 Constraints Experienced by Farmers in Irrigation Tank Management

Umashankari (1991) assessed tank irrigation in the state of Andhra Pradesh in Chittor district. The inadequacy in supply of water by feeder cannals because of non-participation in cleaning of tank bed for cultivation and inadequate repairs, encroachment of tank bed, weed infestation and siltation are responsible for disintegration of the traditional system.

Janakarajan (1993) discussed the economic and social impacts of ground water irrigation in Tamil Nadu. The development of well irrigation in the tank command areas has been the main factors for the downfall of traditional modes of irrigation institutions. The existing regulatory measures and utilization of traditional irrigation systems are totally ineffective in India.

Reddy *et al.* (1993) examined the factors contributing to the deterioration of tank irrigation in Andhra Pradesh with special references to drought prone areas of semi-arid and arid regions. Severe financial stringency coupled with historical, institutional and technological factors influence the decay of tank irrigation system. In their view, tanks had to be restored and maintained in the interest of the ecosystems of these regions. The remedies include periodical maintenance and repair of the tanks, rising bunds and damage weirs to improve their tank capacity lost because of siltation. Afforestation and soil conservation in the tank over water spread area and in foreshore area help to minimize siltation in the tank water spread area.

Angadi (1995) indicated that there was a drastic reduction in actual irrigated area as reflected in the tank register, ranging from 16 per cent to 39 per cent.

This was due to reduced poor capacity of canals, absence of on farm development works, excessive evaporation loss and improper water management practices. At present by restoration, the capacity regained is equal to the volume of silt removed on the principle of parity of silt volume to water volume. It is calculated that the cost of restoring irrigation facility per acre of *achkut* for semi dry crops would be around Rs.80, 000 to Rs. 1, 00,000. Hence, the other method proposed is to raise the waste weir and the tank bund to increase storage capacity, which will be cost effective.

Niranjan Ram(1995) sharing his experience in rehabilitation of tattamachanashalli tank in Devanahalli taluk suggested that water management should be through introduction of coping mechanism in command area by changing crop pattern from paddy to semi dry crops. Around 26% of the tanks have been reduced because of siltation. The excavated silt was disposed to structural strengthening of bund, road expansion, pottery, handicrafts etc. the desiltation cost per cubic meter of silt removed was Rs.32.5 at 1990 prices.

Shivanna (1995) stressed the need for renovation and rehabilitation of irrigation tanks by restoring them to their original capacity. This could be done in two ways *viz* dredging and conveying strengthening and raising the embankment about 1 to 1.5 meters and finally by contour bund method. The contour bunds are used to check the silting of tanks. He also felt the need to create a special division in minor irrigation for rehabilitation and maintenance of tanks, which are the saviours of rural people.

Arumugam and Mohan (1997) examined some major consideration related to tank irrigation systems in South India. The major deficiencies that influence the sustainability are given as inadequate maintenance, reduction in storage

capacity, heavy seepage losses in the delivery system, and poor water management techniques. A pressing need is identified to evolve and implement appropriate strategies that are sound on technical, social, institutional and economical dimensions for sustainable development and management of tank systems. Important practical solutions are discussed for urgent action in the context of sustainable development and management of these irrigation systems.

Sharmaand Khan (1999) showed that the most of the farmers with irrigation facilities was 73.47% but was supplied during kharif season. There were 14.28% respondents who reported that they had irrigation facilities for *kharif* and *Rabi* seasons, 3.06% of respondents were seen to have perennial irrigation facilities while 9.18% were observed to have no irrigation facilities. It was found that canals were the major sources of irrigation. Other sources were ponds, wells and tanks. It was also found that the problems most perceived was that the seasonal irrigation water was not available whereas the least problems faced was having high losses of water due to muddy irrigation channels. It is suggested that the water reservoirs that were used to supply water for irrigation should have more capacity to store comparatively more water, which may be used for irrigating the fields and as protective irrigation for crops during different seasons.

Sidhara (2002) in an evaluative study of watershed programme in Pavagada taluk of Tumkur district in Karnataka was carried out during 2002 and reported that the major constraints in conservation of water and soil practices faced by farmers were loss of cultivable area, water stagnation near bund area and time consuming operations. In case of crop production practices the constraints faced by farmers were non availability of labour, lack of finance,

heavy risk due to failure of monsoon and costly chemicals.

Palanisami (2006) revealed that encroachment of tank bed, privatization and appropriation of the tanks by the government are the main reasons of the failure of local government authority to enact the institutional arrangements under the management regime of common property resources. Wells that considered to be insurance against late monsoon, scarcity of tank water has become a serious threat to the existence of the tanks. A single agency is sufficient for the collection of taxes from the multifaceted uses of the tanks to meet the expenditures for the tanks both in the short period as well as in the long run.

Navaneeth *et al* (2007) conducted an in depth study in the Krishna Basin of Karnataka to documents the potential created, utilization and to identify the constraints in the development of minor irrigation. Minor irrigation components considered for the study included tanks, barrages, pick-ups and lift irrigation schemes (LIS). The study was reported that encroachment and siltation of tank bed, poor maintenance, inadequate power, lack of institutional support were identified as the major constraints in the development of minor irrigation in the basin.

From the above review, it can be concluded that siltation of tank bed, encroachment of tank bed and improper management techniques are the important constraints experienced by farmers in irrigation tank management.

2.10 Research Gap

Tank as a traditional water harvesting system played a pivotal role and served as a life line in the rural economy since ancient time in India. It had been utilized as a source of surface irrigation and domestic purposes from time

immemorial as common property resources. The past literature on tank irrigation is very vast and full of variety. It had been seen from the past literature that over the years researches, academicians had focused on the multiple uses of tank, impact of tank on agricultural production and productivity, causes of decline of tank irrigation system, need for rehabilitation, and benefits of renovation. Efforts had also been taken to find out the causes and constraint of tank maintenance and management, people's participation in tank management system in India. Cost benefit Analysis (CBA) of tank renovation or rehabilitation approach had been incorporated to judge the feasibility of tank renovation programme. All these works on tank irrigation had been undertaken. Mostly in southern states like Kerala, Karnataka, Andra Pradesh, Tamil Nadu and in Pondicherry. Some work had been noticed in Orissa also, but it is matter of great surprise that, West Bengal with large number of water bodies like pond, khal, beal etc had not been studied carefully. Some attempts had been made to capture the role of tank irrigation in agricultural productivity rural livelihood (Sebak Kr. Jana, K. Palnisami and Amit Das, 2012) in dry zones like Purulia, Bankura, Birbhum and some parts of Midnapore. But tank irrigation not only plays a crucial role in dry zones of West Bengal, but plays a significant contribution is the irrigated agriculture in saline zone of West Bengal because of the salinity problem in the ground water rural people basically have to depend on the tank for surface irrigation for agricultural production and for purpose of domestic uses. An exhaustive review of past literature on tank irrigation has enabled the researcher to recognize the gap in the existing literature which had not been studied so far, can be explored. Hence the present proposed study takes an endeavour to find the status, role, productivity,

maintenance and management of tank irrigation in the saline zone of South 24 Parganas district in West Bengal.

2.11 Rationaleof the Study

The somewhat steep gradients of West Bengal offer greater scope for flow irrigation including that from small scale reservoirs/tanks. In the first half of the 20th century, in a large part of West Bengal, tanks were the primary source of irrigation. These small earthen reservoirs stored runoff from the catchments and water from reservoir during rainy seasons. The most important use of water was probably during summer seasons (June – October) itself as insurance against monsoon failure particularly in the critical month of September for use on secondary crops in the winter (Boyce 1987).

The annual rainfall varies in the different parts of West Bengal. North Bengal receives the highest average rain fall 2000 to 4000 mm. In the coastal area rainfall is 2000 mm. In the Gangeatic plain and in the central part of the state rainfall is about 1500-2000 mm and in the Western plateau region, the amount of rainfall received is about 1000 to 1250 mm. Unexpected heavy rainfall occurs in the summer (March -April) due to strong strom like Kalbaishaki. In the south 24 parganas district average annual rainfall is 1750 mm to 1770 mm. This probability of heavy rainfall in the monsoon reciprocate the amount of huge runoff which are stored by small and large tanks in the saline zone of South 24-Parganas and can be utilized as surface irrigation for agriculture.

Among the states, West Bengal is also one of the states with higher number of tanks. The number of tanks has reduced from 4.4 lakhs in 2004 to 4.03

lakhs in 2007 as irrigation development in West Bengal is also biased in favour of well irrigation. Out of 30.48 lakh hectares of irrigated land in West Bengal, 2.47 lakh hectares are irrigated through tanks (2006-07). It indicates that tank irrigation still plays a crucial role in irrigated agriculture in West Bengal in dry zones (like Purulia, Bankura, Birbhum) as well as in saline zone like South 24-parganas, and some part of Midnapore districts.

According 5th minor irrigation census report, 693481 tanks are there in West Bengal, among which 97026 tanks are used for irrigation purposes. South 24-Parganas district has 104151 tanks, among which 11290 tanks are in operation for rain fed irrigation. Percentage of cultivable land covered by irrigation in South 24 Parganas 23.5% (of which ground water is 4% and surface water is 19.4%), where the average of the state is 36.5% (of which ground water is 23.5%, surface water is 12.2%). Irrigation is done in this district mainly by ground water in the blocks closer to Kolkata, but blocks closer to Sunderbans are heavily depended on surface water, basically rainwater harvesting through tanks like ponds, lakes, khal, beal etc. It should be mentioned that recording from the state govt. records, south 24-parganas has the second highest number of tank structures (104151), after Purba Midnapore (211183). But ground water of the district is normally quite salty, except great depth (7300 meter), where apparently a fresh aquifer exists. This aquifer requires the costly techniques of water lifting, which are beyond the ability of rural population for the use of agricultural activities. Moreover, ground water in this district has major problems like arsenic concentration, iron concentration salinity hazards and declining trend of ground water level.

As a consequence of this problem actual area irrigated by ground water during 2000-01 is 139.47 sq.km and area actually irrigated by surface water

during 2000-2001 is 638.923 sq.km. In 2012-2013 a total of 106.280 thousand hectares of land were irrigated by surface water (govt. canal and tank). This present status of irrigation scenario influenced us to focus our study of tank irrigation in five blocks closer to Sunderbans (Bay of Bengal) namely, Patharpratima, Mathurapur-II, Kakdwip, Sagar and Namkhana in south 24 parganas district, which are significantly relied on the surface water (tanks, ponds, khal, beal etc.) for the irrigated agriculture. The results and conclusions of the study may throw some observations and recommendations which will be helpful for the policy implementation for the agricultural development of the district.

2.12 Objectives of the Study

The broad objectives of the present study are the following:

1. To investigate the different characteristics of tank irrigation in the saline zone.
2. To judge the overall status of tanks in saline zone.
3. To investigate the performance of tanks and factors affecting it.
4. To analyse the tank management practices.

It is hypothesized that productivity of tanks varies across different tank management categories such as personal, community and government. It should also be mentioned that tank productivity is influenced by physical factors like the size of the tanks, crop diversification and water availability.

A tank in study area.